PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-149894

(43)Date of publication of application : 10.06.1997

(51)Int.Cl.

A61B 5/14
B60K 28/06
G01N 21/31
G01N 33/49
G06F 3/00

(21)Application number : 07-314195

(22)Date of filing : 01.12.1995

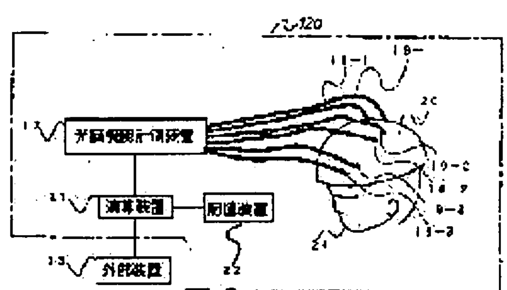
(71)Applicant : HITACHI LTD

(72)Inventor : MAKI ATSUSHI
KOIZUMI HIDEAKI
YAMASHITA YUICHI

(54) LIVING BODY INPUT DEVICE AND LIVING BODY CONTROLLER USING OPTICAL LIVING BODY MEASUREMENT METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To control a computer, a game, an environment controller, a learning level judgement device, the alarming device of a vehicle, diagnostic and alarming devices for medical use, a lie detector, an intention display device and an information transmitter, etc., by measuring localized brain functions and performing input to an external device.



SOLUTION: By an optical brain function measurement device 17, the head part transmission light intensity of a testee is measured by using optical fibers 18-1, 18-2 and 18-3 for irradiation and the optical fibers 19-1, 19-2 and 19-3 for convergence. When the head part transmission light intensity of respective measurement areas measured by the optical brain function measurement device 17 is inputted to an arithmetic unit 21, in the arithmetic unit 21, by using the head part transmission light intensity of the respective measurement areas, the absorption coefficient of oxidized and reduced haemoglobin and data for arithmetic operations stored in a storage device 22, optional output signals are decided and inputted to the external device 23. In the external device 23, an operation is performed corresponding to the kind of input signals.

LEGAL STATUS

[Date of request for examination] 23.08.2001

[Date of sending the examiner's decision of rejection]	16.12.2003
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3543453
[Date of registration]	16.04.2004
[Number of appeal against examiner's decision of rejection]	2004-00996
[Date of requesting appeal against examiner's decision of rejection]	15.01.2004
[Date of extinction of right]	

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention by inputting into an external device the output signal from the living body input unit which used the Mitsuo object mensuration Control equipment about the control device which performs various control, without using a keyboard, a mouse, and a handle in detail, or It is related with the living body input unit and biological control equipment using the Mitsuo object mensuration which controls a nap alarm, controls environmental equipment, judges whenever [study], displays the feeling and thinking of a small child, a sick person, an animal, etc., or discovers a lie.
[0002]
[Description of the Prior Art] Conventionally, equipments, such as a computer and a game, are controlled from the input unit with various keyboards, mice, handles, etc., in order to operate. However, the input unit which such human being operates on hand and foot is difficult for reducing the presence in a game or a physically handicapped person etc. operating it. Then, the equipment which performs the direct input from a brain using an electroencephalogram is proposed by JP,7-124331,A. It is going to control the computer, especially the game machine by this equipment by inputting an electroencephalogram into a computer as it is like [when measuring an electrocardiogram]. Control of the external device of the patient by whom a failure is accepted in a motor function is possible for the direct input device from such a brain, and the contribution to a physically handicapped person's social participation is also expected.
[0003]
[Problem(s) to be Solved by the Invention] By the way, field division is carried out by different cytoarchitecture, and each field shares a different function further so that human being's brain may be expressed with Broadmann's atlas of brain. For example, if a brain is seen from width, the field where the field where the field which participates in spontaneous movements (a hand, a finger, guide peg, etc.) participates in the summit section, feeling, vision, etc. participates in the regio occipitalis capitis and language will be the predetermined section of a left half, and will be shared, respectively. Thus, in order to extract the information from the pinpointed location with high degree of accuracy, it is necessary to use a metering device with high spatial resolving power. However, since a dielectric constant is uneven in a living body and the source location of a signal becomes indefinite, the electroencephalogram used in the conventional technique has low spatial resolving power. Moreover, in order that the myoelectric potential by analyte moving might be greatly reflected in a signal and might have a bad influence on electroencephalogram detection by this, there is also a constraint that analyte must be restrained, at the time of measurement, and practicality was very missing. Therefore, the approach using an electroencephalogram as an input signal from a brain has a problem in precision and practicality directly. The purpose of this invention is by solving such a conventional technical problem and using a somatometry signal with high spatial resolving power as an input signal to offer the living body input unit and biological control equipment using the high somatometry approach of precision and practicality.
[0004]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the living body input unit using the Mitsuo object mensuration by this invention Since the passage light of this living body skin is condensed by irradiating said living body skin from at least one Mitsuteru gunner stage arranged on the living body skin, and this optical exposure means, At least one condensing means arranged on this living body skin, and a photodetection means for somatometry to measure the living body passage light reinforcement condensed by this condensing means, A storage means to set up beforehand the reinforcement in the hemoglobin concentration rate of change of the arbitration time interval which should be calculated, and the arbitration frequency of time amount change of hemoglobin concentration etc. as reference data of a feature parameter, and to memorize this, From the measurement signal measured by said

photodetection means, or living body passage light reinforcement The oxyhemoglobin concentration change value within a brain of the arbitration location within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value is calculated. The value of the feature parameter of arbitration is calculated from this change value, and it is characterized by providing an operation means to determine the class of output signal from the data memorized by the value and said storage means of a feature parameter of this arbitration. Moreover, the biological control equipment using the Mitsuo object mensuration by this invention inputs the output signal determined with the above-mentioned living body input unit, and is characterized by providing the external device which operates an arbitration function according to the class of inputted signal. Here, although the light condensed by arrangement of the Mitsuteru gunner stage and a condensing means is classified into the reflected light and the transmitted light, it considers all as passage light including both in this invention.

[0005]

[Embodiment of the Invention] In this invention, the cerebral function activities localized using light are measured, and the measured signal is used as an input signal to a computer or an external device. That is, the signal measured, respectively is inputted into an arithmetic unit by setting one or more optical fibers for an exposure, and one or more optical fibers for condensing as one or more measurement fields (for example, the right-hand finger motor area, the left-hand finger motor area, the speech center, etc.) of a head, and condensing the head passage light of the subject. In an arithmetic unit, the class of output signal, such as clicking [in cursor] cursor from the measurement signal itself to migration and the input of the speech center to the input of migration and left-hand finger movement to the input of right-hand finger movement for example, on right-hand side to left-hand side, is determined, and an output signal is inputted into external devices, such as a computer, a word processor, or a game machine. An external device performs actuation according to the class of input signal. By other approaches of an arithmetic unit, by calculating the oxyhemoglobin concentration change value within a brain, a reduction hemoglobin concentration change value, or the total hemoglobin concentration change value from the measured passage light reinforcement, calculating the description parameter value from these values, and comparing the description parameter value memorized by storage with the calculated description parameter value, the class of output signal is determined and an output signal is inputted into an external device. Furthermore, the ** which does not make the input signal of an external device correspond to each measurement field as other measurement approaches, The subject is made to imagine "it clicks" etc. "cursor -- the right -- " -- "cursor -- the left -- " -- The standard-deviation value and average value for every feature parameter for every measurement field are memorized as study data to the store, and actual measurement values are compared with those study data, and if it is in tolerance and is in agreement, it will consider as an output signal. [at that time] In order to determine the class of output signal by this approach using a feature parameter, the Mahalanobis distance can be used, and also a neural network can also be used. Here, the Mahalanobis distance is an index which judges whether an actual measurement value belongs to the distribution, when a measurement value etc. is expressed by the normal distribution which has distribution. Since a computer, a word processor, or a game machine can be controlled by this, without using a keyboard, a mouse, etc., it can use also as an object for trouble back tone. Furthermore, it is [whenever / nap alarm / of an operator / environment control unit, and study] applicable to declaration-of-intention equipments, such as judgment equipment, a sick person, a small child, and an animal, a data transmission unit, or the lie detector by arranging many the exposure light means and the condensing means of a point to analyte.

[0006]

[Example] Hereafter, a drawing explains the principle of operation and the example of this invention to a detail. Drawing 1 is the outline block diagram of the equipment (it abbreviates to an optical cerebral function metering device henceforth) which measures the cerebral function activities localized using light. In this invention, the localized cerebral function activities are measured using light, and the measured signal is made into the input signal to a computer. Here, oxyhemoglobin concentration change and reduction hemoglobin concentration change are measured independently, respectively by using two waves for exposure wavelength for the purpose of the oxidization in a living body, and reduction hemoglobin concentration change measurement. That is, oxyhemoglobin concentration and reduction HEMOKUROBIN concentration are measured by the difference in a color by the absorption of light. If wavelength is increased further, while precision will improve, measurement of matter concentration other than oxidization and the reduced hemoglobin is possible. Although the case where an optical exposure location and one photodetection location are set up is explained here, it is easy to increase a number, respectively. The light of specific wavelength is emitted from the light source 1-1 and 1-2, and incidence is carried out to an optical fiber 2-1 and 2-2, respectively. Here, the wavelength from the light source 1-1 is lambda 1, is the wavelength lambda 2 from the light source 1-2, and is chosen from the range of 400 to 2400nm. When measuring the hemodynamics in a living body especially, it is desirable to choose from the range of 700 to 1100nm so that a wavelength difference may be set to less than 50nm in order to raise

precision. That is, in this wavelength range, the permeability of light is high. Since the crystal of water also becomes large on the wavelength beyond this and absorption of the hemoglobin blood itself also becomes large less than [this], it is inconvenient. Moreover, intensity modulation of the light source 1-1 and 1-2 is carried out on the frequencies f1 and f2 which change with the drive circuit 4-1 and 4-2, respectively. Each drive circuit 4-1 and the signalling frequency from 4-2 are inputted into a phase detector 9-1 and 9-2 as reference signalling frequency, respectively. This is for taking out oxidization and a reduction hemoglobin concentration value from the wavelength with which oxidization and a reduction hemoglobin concentration change value were mixed separately.

[0007] An optical fiber 2-1 and 2-2 have connected with an optical directional coupler 3, it is mixed and incidence of the light source 1-1 and the light from 1-2 is carried out to the optical fiber 5 for an exposure. the scalp of the optical fiber 5 for an exposure to the subject 6 -- from a top, light is irradiated and living body passage light is condensed with the optical fiber 7 for condensing. This measures the difference in the color by ** of the oxidization which flows the inside of blood, and reduction hemoglobin concentration. In the artery, although the saturation of oxygen (rate that the oxyhemoglobin in [all] hemoglobin occupies) is high, in the vein, the saturation of oxygen is falling as compared with an artery. Here, although distance between the optical fiber 5 for an exposure and the optical fiber 7 for condensing is made into the distance of 10-50mm with a measurement location, it is set to 30mm by this equipment configuration. living body passage light [in / incidence of the living body passage light condensed with the optical fiber 7 for condensing is carried out to a photodetector 8, respectively and / each condensing location] -- photo electric conversion -- and it is amplified. A photo-multiplier and an avalanche photodiode are used for a photodetector 8. After the output signal from a photodetector 8 is distributed two times, it is inputted into a phase detector 9-1 and 9-2. Although two waves of irradiated living body passage light is being mixed to the Gentlemen phase wave detector 9-1 and the signal inputted into 9-2 Since reference freqency is inputted into the Gentlemen phase wave detector 9-1 and 9-2 from the drive circuit 4-1 and 4-2, respectively, in a phase detector 9-1, living body passage light reinforcement from the light source 1-1 can be carried out, and separation detection of the living body passage light reinforcement from the light source 1-2 can be carried out in a phase detector 9-2.

[0008] After inputting respectively into an analog-digital converter (it abbreviates to an A/D converter henceforth) 10-1, and 10-2 the living body passage light signal on the strength detected by phase discriminator 9-1 and 9-2 and changing it into a digital signal, it incorporates to an arithmetic unit 11. In an arithmetic unit 11, from the time series signal of two waves of incorporated passage light reinforcement, the sum showing oxyhemoglobin concentration, reduction hemoglobin concentration, and blood volume of oxyhemoglobin concentration and reduction hemoglobin concentration is calculated, and it displays on a display 12 as a time series graph. The amount (volume) of the hemoglobin in blood is fixed, and if an oxyhemoglobin and the reduced hemoglobin are only added, the whole blood volume understands it. The method of calculating the oxyhemoglobin, the reduced hemoglobin, and the total hemoglobin concentration change accompanying cerebral function activities by this equipment configuration is proposed by for example, these people with the Japanese-Patent-Application-No. No. 30972 [seven to] specification, and the drawing (the data-processing approach). In addition, although only the amount from which hemoglobin concentration changed is calculated, if the operation except dispersion in a living body is performed, the absolute magnitude of concentration is also measurable here.

[0009] Drawing 2 is drawing showing the hemoglobin concentration change at the time of right-hand finger movement by the optical cerebral function metering device. Here, the field within the brain which participates in a motion of a right-hand finger (it abbreviates to the right-hand finger motor area henceforth) is made into a measurement field using this equipment, and time amount change of the oxyhemoglobin 14-1 at the time of performing right-hand finger movement, the reduced hemoglobin 14-2, and the total hemoglobin concentration change 14-3 is shown. In addition, 13 is a right-hand finger movement period. Drawing 3 is drawing showing the hemoglobin concentration change at the time of left-hand finger movement by the optical cerebral function metering device. Here, using this equipment, the left-hand finger motor area is made into a measurement field, and time amount change of the oxyhemoglobin 16-1 at the time of performing left-hand finger movement, the reduced hemoglobin 16-2, and the total hemoglobin concentration change 16-3 is shown. In addition, 15 is a left-hand finger movement period. If drawing 2 and drawing 3 are compared, the oxyhemoglobin concentration change 14-1 by the right-hand finger motor area and the total hemoglobin concentration change 14-3 during the right-hand finger movement period 13 show about 3 times as much variation as the oxyhemoglobin concentration change 16-1 by the left-hand finger motor area in the left-hand finger movement period 15, and the total hemoglobin concentration change 16-3 so that clearly. In addition, the motor area in cerebral left-hand side is an operating range related to a right half the body, and the field within a brain and the body part which involves have cross relation mutually. Moreover, the reduced hemoglobin does not carry out fluctuation so notably.

[0010] Drawing 4 is drawing showing the contour-line graph of the total hemoglobin concentration change at the time

of right-hand finger movement by the optical cerebral function metering device. Here, using this equipment, it measures by the multipoint so that the right-hand finger motor area may be included, and the contour-line graph of the total hemoglobin concentration change at the time of performing right-hand finger movement is shown. By drawing 4 , left-hand side shows a before [a brain] side, and right-hand side shows [the vertical direction of drawing 4] the backside [the brain] for the cerebral upper and lower sides. Drawing 4 shows that the local part which shows such a remarkable change is measured by the optical cerebral function metering device. Drawing 5 is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of the language remembrance by optical cerebral function equipment. Here, it measures by the multipoint so that the field (it abbreviates to the speech center henceforth) which participates in language activities may be included, and the contour-line graph of the oxyhemoglobin concentration change at the time of recollecting language is shown. The speech center exists in the location near the tempora within a left-hand side head brain. Also in this case, the local part which shows a remarkable change is measured by the optical cerebral function metering device. An optical cerebral function metering device can also measure the cerebral function activities by remembrance in this way. Therefore, in this invention, precision and practicality can realize the direct-input approach from a high brain by using the signal measured with the optical cerebral function metering device as an input signal to an external device.

[0011] Since the outline of the principle of invention was described above, below, the example of this invention is described. Drawing 6 is the block diagram of the optical cerebral function metering device in which one example of this invention is shown. In drawing 6 , 120 is a living body input unit, 23 is an external device and biological control equipment consists of these living body input unit 120 and an external device 23. The head transmitted light reinforcement of the subject 6 is measured using the optical cerebral function metering device 17, the optical fiber 18-1 for an exposure, 18-2 and 18-3, the optical fiber 19-1 for condensing, 19-2, and 19-3. the optical fiber 18-1 for an exposure, and the optical fiber 19-1 for condensing -- the optical fiber 18-3 for an exposure and the optical fiber 19-3 for condensing are being fixed to the measurement field 1 for the optical fiber 18-2 for an exposure, and the optical fiber 19-2 for condensing by the measurement field 2 with the optical-fiber fixed helmet 20 to the measurement field 3, respectively. It is easy to increase the number of measurement fields here, and in each measurement field, in order to improve spatial resolving power, it is also easy to arrange two or more optical fibers. The head passage light reinforcement of each measurement field measured by the optical cerebral function metering device is inputted into an arithmetic unit 21. Using the absorbancy index of the oxidization memorized by the head passage light reinforcement and the store 22 of each of said measurement field, and the reduced hemoglobin, and the data for an operation, by the operation approach mentioned later, the signal of arbitration is specified and it inputs into an external device 23 in an arithmetic unit 21. In order to judge what kind of semantics the signal has in storage 22 beforehand, the result (the absorbancy index and data for an operation of HEMOKUROBIN) learned by then is memorized. In an external device 23, it operates according to the class of said inputted arbitration signal. As an external device 23, a computer, a word processor, a game machine, or a communication device can be used.

[0012] Next, the operation approach in the arithmetic unit 21 in drawing 6 is explained. Drawing 7 is a flow chart which shows the procedure of the arithmetic unit in drawing 6 . For example, the optical fiber 18-1 for an exposure and the optical fiber 19-1 for condensing are set as the left-hand finger motor area (measurement field 1), the optical fiber 18-2 for an exposure and the optical fiber 19-2 for condensing are set as the right-hand finger motor area (measurement field 2), the optical fiber 18-3 for an exposure and the optical fiber 19-3 for condensing are set as the speech center (measurement field 3), and the living body passage light reinforcement in each measurement field is inputted into an arithmetic unit 20.

(step 1-1) From the passage light reinforcement of each wavelength from the measurement field 1-1, oxidization, reduction, or the total hemoglobin concentration is calculated.

(step 1-2) Each **** calculated by step 1-1 calculates a feature parameter from the hemoglobin concentration of arbitration, i.e., oxidization, reduction and the total hemoglobin concentration, or one concentration in them. As a feature parameter, as for the addition value of the hemoglobin concentration of arbitration, and each **** of arbitration time amount, the reinforcement of the arbitration frequency of time amount change of the hemoglobin concentration of arbitration is used for each **** of an arbitration time interval, as for the rate of change and each **** of hemoglobin concentration of arbitration, and this can be determined variously, for example.

(step 1-3) measuring with the study value in storage 22 the description PARA meter calculated by step 1-2 -- the description parameter value -- oh, it judges whether it is in the threshold range of the arbitration which has carried out an Ecklonia setup, and a signal 1 will be outputted if it is within the limits. Moreover, if out of range, it will progress to step 1-4.

[0013] (step 1-4) From the passage light reinforcement of each wavelength from the measurement field 2, oxidization,

reduction. or the total hemoglobin concentration is calculated.
(step 1-5) From the hemoglobin concentration of arbitration, each **** calculated by step 1-4 calculates a feature parameter. As a feature parameter, reinforcement [in / **** / the addition value of the hemoglobin concentration of arbitration and / of arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used, for example, and this can be determined variously.
(step 1-6) It judges whether it is in the threshold range of the arbitration set up beforehand, and if the description PARA meter calculated by step 1-5 is within the limits, it will output a signal 2. Moreover, if out of range, it will progress to step 1-7.
(step 1-7) From the passage light reinforcement of each wavelength from the measurement field 3, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 1-8) From the hemoglobin concentration of arbitration, each **** calculated by step 1-7 calculates a feature parameter. As a feature parameter, reinforcement [in / **** / of the addition value of the hemoglobin concentration of arbitration or an average value, or arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used, for example, and this can be determined variously.
(step 1-9) It judges whether it is in the threshold range of the arbitration set up beforehand, and if the description PARA meter calculated by step 1-8 is within the limits, it will output a signal 1. Moreover, if out of range, it will return to step 1-1.
[0014] Here, the external device 23 is always changed into the waiting state waiting for an input supposing an external device 23 being a computer. Furthermore, it is possible to also make the function of an external device [beforehand as opposed to / cursor / to the input of the left and a signal 2 / to the input of the right and a signal 3 / like a click / a signal in cursor] correspond beforehand to the input of a signal 1. Moreover, as an escape of this operation approach, if it is made to output [in in a threshold range] 1 in step 1-3, step 1-6, and step 1-9 in besides 0 and a threshold range, eight kinds of combination can be made as a signal outputted from an arithmetic unit 21 (000-111). In this case, what is necessary is to perform the output from a signal 1 to a signal 8, and just to opt for arbitration functional actuation of the external device 23 corresponding to each signal beforehand. Thus, by the 1st example of an operation, the right-hand finger motor area, the left-hand finger motor area, and the speech center were defined beforehand, it is the case where a signal is measured for every location of the, and the case where a signal and functional actuation were made to correspond to 1 to 1 was stated.
[0015] Drawing 8 is a flow chart which shows the 2nd example of an operation procedure of the arithmetic unit in drawing 6 . In the 2nd example of the operation approach, it is the case where the signal inputted into an external device 23 as the oxidization, the reduction, or the total hemoglobin concentration change measured in each measurement field is not made to correspond to 1 to 1. For example, it is the approach of having aimed for every location in the case of the 1st example of the operation approach, having taken out the signal to it, and having made the specific signal corresponding to functional actuation. However, when it has the volition a user wants to move cursor to the left, it will have to recollect moving a left hand and will become the function of an actual external device, and the thing from which remembrance of a user was widely different. On the other hand, in the 2nd example of this operation approach, it is an approach in consideration of said trouble. First, i measurement fields are set up, the optical fiber for an exposure and the optical fiber for condensing are arranged to each measurement field, and the living body passage light reinforcement in each measurement field is inputted into an arithmetic unit 21. That is, in the 2nd example, it aims for every location, and a specific signal is not measured, but an optical fiber is connected to a head, without pinpointing a location concretely, optical cerebral function measurement when recollecting the actuation inputted into a computer is performed, this is performed several times, and is learned, and the result is beforehand memorized to storage 22. And it searches for whether concentration is calculated from the actually measured signal, a feature parameter is calculated, and the feature parameter same in the data of a store 22 exists this. Hereafter, it explains in accordance with the flow of drawing 8 .
[0016] (step 2-1) From the passage light reinforcement of each wavelength from each measurement field i of every, oxidization, reduction, or the total hemoglobin concentration is calculated.
(step 2-2) From the hemoglobin concentration of arbitration, each **** calculated by step 2-1 calculates the values Pi and j (matrix value) of each feature-parameter j of each measurement field i of every. As a feature parameter, reinforcement [in / **** / the addition value of the hemoglobin concentration of arbitration and / of arbitration time amount / each / **** / of an arbitration time interval / each / in the rate of change and each **** of hemoglobin concentration of arbitration / the arbitration frequency of time amount change of the hemoglobin concentration of arbitration] is used here, for example, and this can be determined variously.

(step 2-3) Here, the class of signal outputted from an arithmetic unit 21 is made into k kinds. The study data of general to a store 22 or a user individual are memorized beforehand. Study DS is the standard deviation value and the average of each feature-parameter j of every of each measurement field i of every which have the same structure in each output signal k of every. Namely, it is premised on probability distribution of a feature parameter being GAUSHIAN distribution. A standard deviation value and the average can describe a gauss function. For example, when an external device 23 is assumed to be a computer and the signal k from an arithmetic unit 21 is beforehand inputted into said computer, it sets up so that cursor may move to the right. Moreover, a user carries the optical cerebral function metering device 17 beforehand, and it performs recollecting with "cursor is moved to the right" two or more times. At this time, a standard deviation value and the average are calculated to each feature-parameter j of every [of each measurement field i of every / which is measured]. The standard-deviation value and average value of each feature-parameter j of every of each measurement field i of every which were acquired here are memorized to storage 22 as study data of Signal k. In this step 2-3, said study data Di, j, and k memorized are read. Drawing 9 is drawing showing the DS of these study data Di, j, and k. In drawing 9 , S expresses a standard deviation value, A expresses the average, and a dotted line means an abbreviation. Moreover, the measurement field i is made into n places, and the number of classes of feature-parameter j is made into m kinds.

[0017] (step 2-4) The Mahalanobis distance MDk is calculated to each signal k of every using the values Pi and j of all the study data Di, j, and k memorized and each feature-parameter j of each measurement field i of every [which was calculated step2-2]. The Mahalanobis distance is expressed with an easy well-known formula.

(step 2-5) It searches for the minimum Mahalanobis distance MDk from the Mahalanobis distance MDk of each signal k of every [which was calculated by step 2-4]. If the minimum value in 1-k signals is chosen, it will serve as the minimum Mahalanobis distance.

(step 2-6) It judges whether the minimum Mahalanobis distance MDk is in the threshold range of arbitration. In being in within the limits, it progresses to step 2-7. Moreover, in being out of range, it returns to step 2-1.

(step 2-7) Signal k is outputted.

[0018] Although the operation approach of the 2nd example applies the Mahalanobis presumption approach, in order to perform same presumption, it also has a method of applying a neural network as the 3rd operation approach. In this case, each feature-parameter j of each measurement field i of every is inputted into neural network input-side each terminal, and each signal k (k=1-l) is assigned to output side each terminal. Beforehand, the neural network learns by use of the multiple times of every user and a common user so that the signal k of arbitration may be outputted with the value of each feature-parameter j of each measurement field i of every. By using this neural network that learned, it can function as Mahalanobis presumption shown in drawing 8 similarly, and the signal corresponding to what the user recollected can be outputted. In drawing 6 , a neural network is connected to the latter part of an arithmetic unit 21, and a feature parameter is inputted into input-side each network terminal. An external device 23 is connected to output side each network terminal. In addition, of course, the arithmetic unit other than the operation approach of the 1st example, the 2nd example, and the 3rd example can also determine the class of output signal, using directly the signal measured by the detector for optical cerebral function measurement.

[0019] Drawing 10 is the block diagram of the biological control equipment in which other examples of this invention are shown. drawing 10 -- setting -- 101 -- an operator and 102 -- a handle and 103 -- a seat and 104 -- an automobile and 105 -- a drive circuit and 106 -- a loudspeaker and 107 -- an optical-fiber fastener or an optical-fiber fixed helmet, and 108 -- the optical fiber for an optical exposure, and 109 -- for the living body light measurement section and 112, as for a signal line and 114, the input signal judging section and 113 are [the optical fiber for optical condensing, and 110 / an input unit and 111 / a microcomputer and 115] storage. This example shows the case where biological control equipment is applied as a nap alarm at the time of automobile operation. That is, the input device 110 (the somatometry section 111, the input signal judging section 112, the optical fiber 108 for an optical exposure, the optical fiber 109 for optical condensing, an optical-fiber fastener, or optical-fiber fixed helmet 107) constitutes the living body input device, and the microcomputer 114 is used as an external device. The condition that an operator 101 sits on a seat 103, operates a handle 102, and is driving the automobile 104 is shown. The operator 101 is wearing the optical-fiber fastener or the optical-fiber fixed helmet 107. One or more sets of optical fibers 108 for an optical exposure and the optical fiber 109 for optical condensing are being fixed to the optical-fiber fastener or the optical-fiber fixed helmet 107. From the optical fiber 108 for an optical exposure, light is irradiated by an operator's 101 head and living body passage light is always condensed with the optical fiber 109 for optical condensing currently fixed by arbitration distance(for example, about 30mm)-separating. The light source of light irradiated from the optical fiber 108 for an optical exposure has similarly the photodetector which detects the light which is in the living body light measurement section 111 in the input-device 110 interior, and was condensed with the optical fiber 109 for optical condensing in the living body light measurement

section 111.

[0020] If the phase detection of the living body passage light reinforcement which gave modulation frequency on the strength which is different about the optical reinforcement irradiated for every different optical exposure location and every different wavelength, was detected by the photodetector, and was changed into the electrical signal carries out and it measures as shown here in the example shown in drawing 6 , it is possible to remove the effect of the stray light and to measure the living body passage light reinforcement for every wavelength for every measurement location. Although the arbitration multi-statement of the measurement location defined by 1 set of optical fibers 108 for an optical exposure and the optical fiber 109 for optical condensing is carried out and it does not interfere every operator 101, when the high regio frontalis capitis of living body permeability and the characteristic part where hemodynamics changes with sleepiness notably again are known beforehand, it is set as said characteristic part. Based on the measurement signal showing the head hemodynamics measured in the living body light measurement section 111, the signal of sleepiness is extracted in the input signal judging section 112. It consists of arithmetic units which perform the storage with which the constant data which needs the input signal judging section 112 for hemodynamics operations, such as optical parameters, such as hemoglobin, and the study data about an operator 101 are memorized, the operation of hemodynamics, and the judgment of an input signal here. Moreover, as the 3rd example of an operation procedure showed, it is also possible to use a neural network for the judgment of an input signal. Here, when an operator's 101 sleepiness is detected in the input signal judging section 112, close is carried out to a microcomputer 114 using a signal line 113 from an input unit 110, and a signal is outputted to the nap alarm which consists of a drive circuit 105 and a loudspeaker 106 from a microcomputer 114. A nap alarm will function on a loudspeaker 106 as uttering the voice of warning, if a signal is inputted. Here, it is possible to stimulate by various approaches, such as stimulating an operator with voice and also vibrating a stimulus or a seat with light as a function of the nap alarm 105. Moreover, the voice data memorized by the store 115 according to the level of an alarm can be chosen from a microcomputer 114, and the speech information which has the semantics called "risk and risk ..." can also be outputted. Moreover, it is also possible to input a signal into a nap alarm by the electromagnetic wave, without carrying out the interior of the input device 110 to the optical-fiber fastener 107, and using a signal line 113. Furthermore, when a microcomputer 114 judges that the alarm level went up, by carrying out signal transduction to a downward arrow head from a microcomputer 114, brakes are applied or it is considering as the configuration which can also output the signal which suspends an engine.

[0021] as an alarm -- not only the automobile of drawing 10 but all migration means, such as an airplane and an electric car, -- being applicable -- under operation of these migration means -- sleepiness, fatigue, and since -- admiration -- a redout, a blackout, etc. are applicable as equipment which judges the feeling which causes trouble to operation and gives an alarm to it. In addition, a redout and a blackout are symptoms which the blood flow within a brain concentrates on a part with big acceleration, and cause loss of visual disorder or consciousness during operation of an airplane etc. Thus, if a living body input unit is used as an input unit of a microcomputer, it is applicable also as an environment control unit, for example. That is, subjective feelings, such as a cold hot relaxed feeling, can be judged, and it can use as equipment which can control environments, such as environmental temperature, environmental music, brightness, and an image. Moreover, it is [whenever / study] applicable also as judgment equipment. That is, extent of study, such as learning and movement (rehabilitation is also included), is judged, and it can be used as equipment which displays the skill level. Based on the displayed skill level, it can also use as training equipment with which a test subject trains repeatedly. Moreover, it is applicable also as a medical-application diagnosis and an alarm. That is, it is applicable to the diagnostic equipment for epilepsy focal decision, the equipment of cerebral function inspection of an encephalopathy patient, the alarm of an epileptic stroke, etc. Moreover, although an intention cannot be transmitted outside from the patient of the myonosus or a vegetative state, a small child, an animal, etc. or an intention does not pass, it is applicable also as equipment which displays feeling and thinking. It catches that the small child considers being more concretely shown by him with a living body input device, and it is changed into a digital electrical signal, it inputs into a microcomputer, the language which has semantics in memory beforehand is registered, the selection judging of it is carried out, and it outputs with voice. Moreover, the information from an infantile brain is caught with a living body input unit, change of the brain of **** is detected, it is made into a phoneme, it can input into an electronic speech circuit and volition can be made to transmit by making into a voice what the small child considers. furthermore, what is wanted by attaching in animals, such as an animal and a pet, -- it can know a thing. Moreover, feeling, such as joy, anger, humor and pathos, can be judged, and it can apply also to the equipment which transmits feeling information with a TV phone etc. From the feeling information transmitted by this equipment, the expression of the computer graphics of the face displayed on a **** side is generable. Moreover, concentration can be judged and it can apply also to the equipment which displays this. Furthermore, it is applicable also as lie detector.

[0022]

[Effect of the Invention] Since according to this invention the localized cerebral function is measured with an optical cerebral function metering device and a measurement signal is used as an input signal to an external device as explained above, an external device can be controlled, without using a keyboard, a mouse, and a handle, and also it is [whenever / alarm / of a vehicle /, environment control unit, and study] applicable to judgment equipment, a medical-application diagnosis and an alarm, declaration-of-intention equipment, a data transmission unit, concentration judging equipment, the lie detector, etc. Therefore, communication with information the non-transmitted object which was not made is attained conventionally.

[Translation done.]

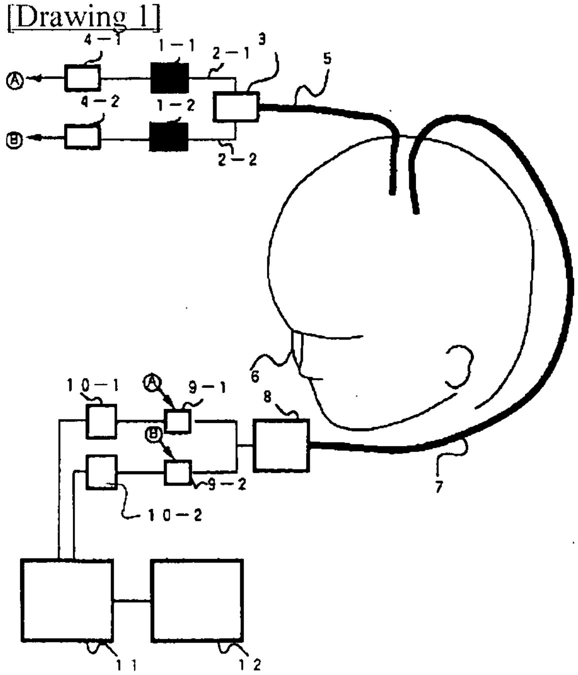
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the optical cerebral function metering device in which one example of this invention is shown.
[Drawing 2] It is drawing showing the hemoglobin concentration change at the time of right-hand finger movement by optical cerebral function equipment.
[Drawing 3] It is drawing showing the hemoglobin concentration change at the time of left-hand finger movement by optical cerebral function equipment.
[Drawing 4] It is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of right-hand finger movement by optical cerebral function equipment.
[Drawing 5] It is drawing showing the contour-line graph of the total hemoglobin concentration change at the time of the language remembrance by optical cerebral function equipment.
[Drawing 6] It is the concrete equipment configuration Fig. of this invention.
[Drawing 7] It is the flow chart which shows the operation procedure of the arithmetic unit in drawing 6 .
[Drawing 8] It is the flow chart which shows other operation procedures of the arithmetic unit in drawing 6 .
[Drawing 9] It is drawing of the study DS memorized to the store of drawing 6 .
[Drawing 10] It is a block diagram at the time of applying the living body input unit based on this invention to the nap alarm at the time of automobile operation which is an external device.
[Description of Notations]
1-1 and 1-2 : The light source, 2-1, 2-2 : An optical fiber, 3: An optical directional coupler, 4-1, 4-2 : A light source driving gear, 5: The optical fiber for an exposure, 6: The subject, 7: The optical fiber for condensing, 8: A photodetector, 9-1 : A phase detector, 9-2 : A phase detector, 10-1 : An analog-digital converter, 10-2 : An analog-digital converter, 11: An arithmetic unit, 12: A display, 13: A right-hand finger movement period, 14-1 : Oxyhemoglobin concentration change, 14-2 : Reduction hemoglobin concentration, 14-3 : The total hemoglobin concentration, 15: A left-hand finger movement period, 16-1 : Oxyhemoglobin concentration change, 16-2 : Reduction hemoglobin concentration, 16-3 : The total hemoglobin concentration, 17: An optical cerebral function metering device, 20: An optical-fiber fixed helmet, 18-1, 18-2, 18-3 : The optical fiber for an exposure, 21:arithmetic unit, 19-1, 19-2, the optical fiber for 19-3:condensing, 22:storage, 23:external device, 24:user, a 101:operator, a 102:handle, a 104:automobile, a 106:loudspeaker, 111 : The Mitsuo object measurement section, 112: The input-signal judging section, 114: Microcomputer (microcomputer)
113: A signal line, a 110,120:living body input device, a 103:seat, a 105:nap alarm, the optical fiber for a 108:light exposure, a 107:optical-fiber fastener or an optical-fiber fixed helmet, 109 : the optical fiber for optical condensing.

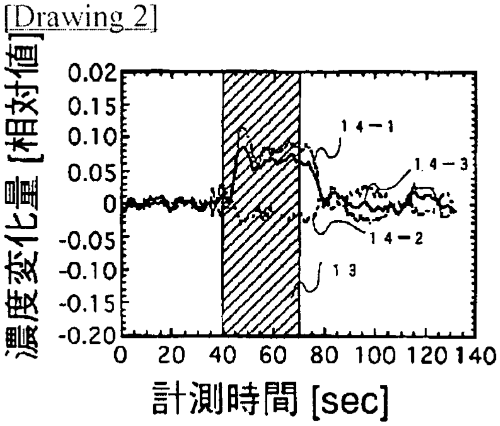
[Translation done.]

DRAWINGS

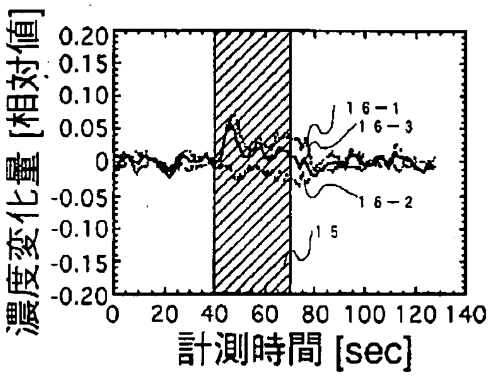
[Drawing 1]



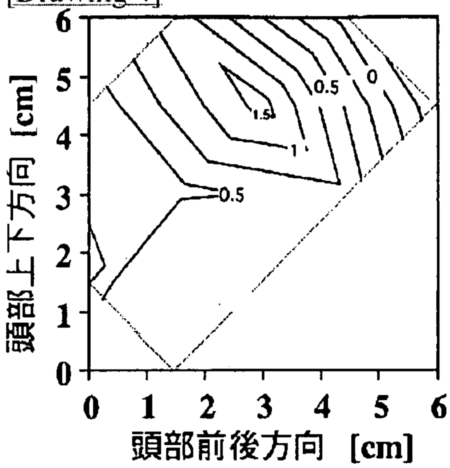
[Drawing 2]



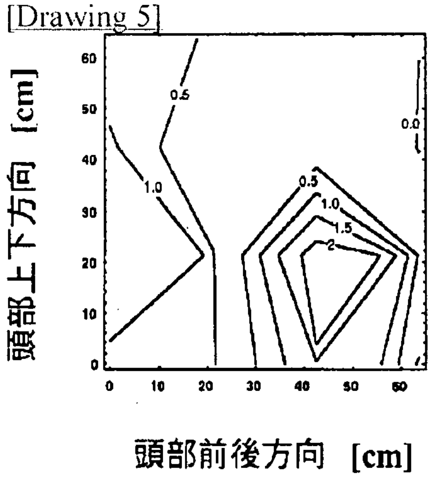
[Drawing 3]



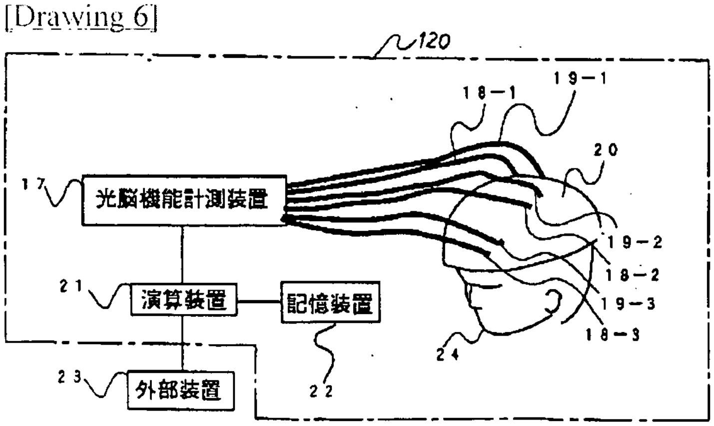
[Drawing 4]



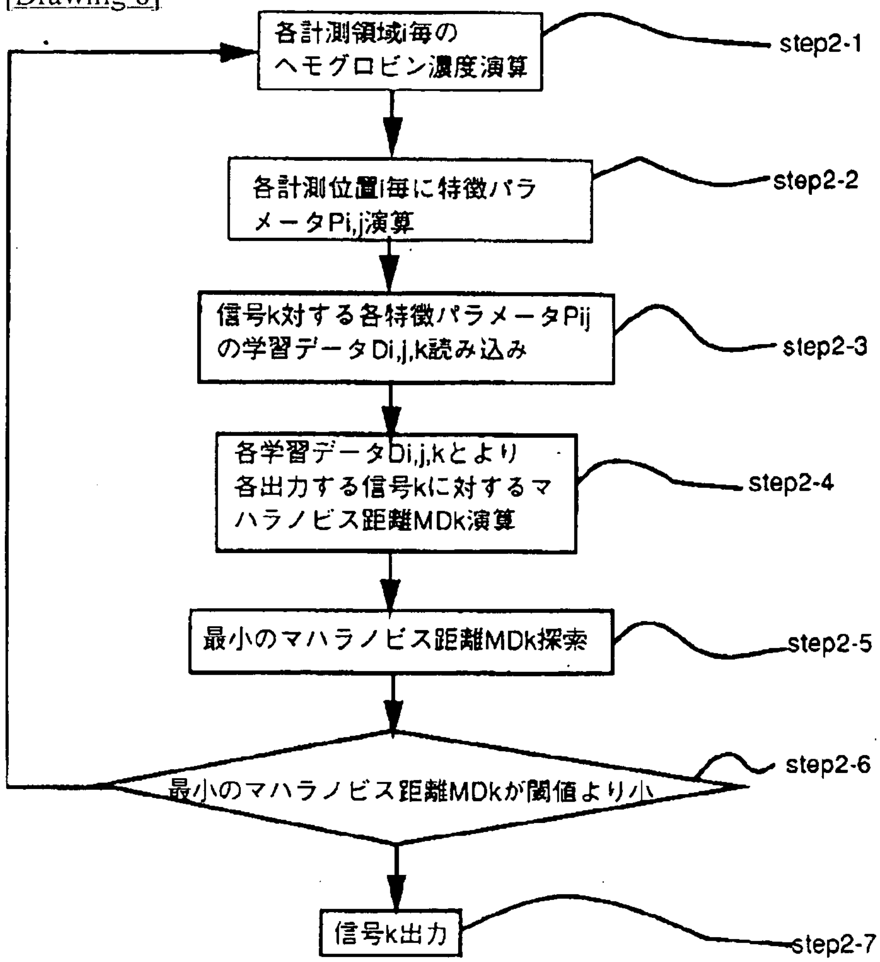
[Drawing 5]



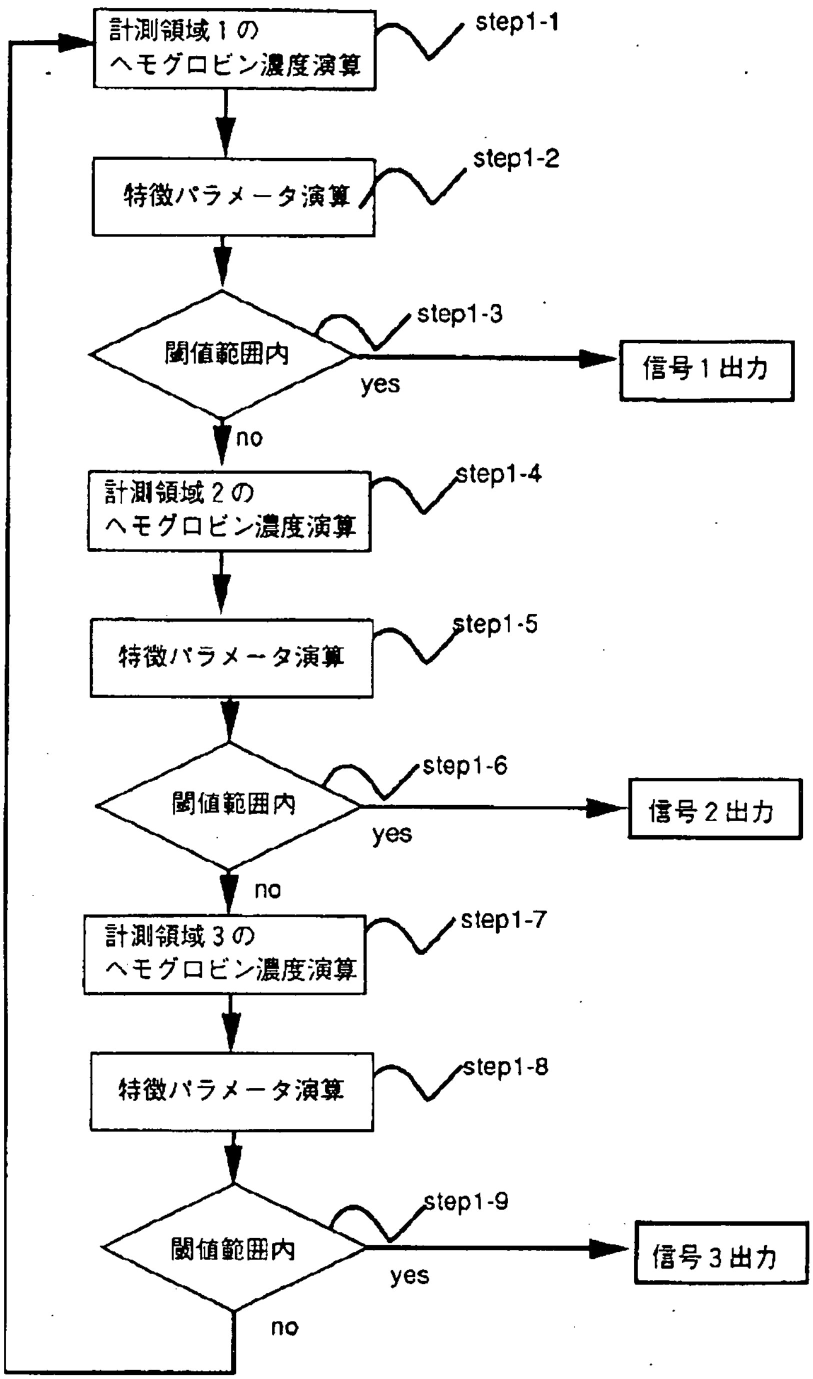
[Drawing 6]



[Drawing 8]



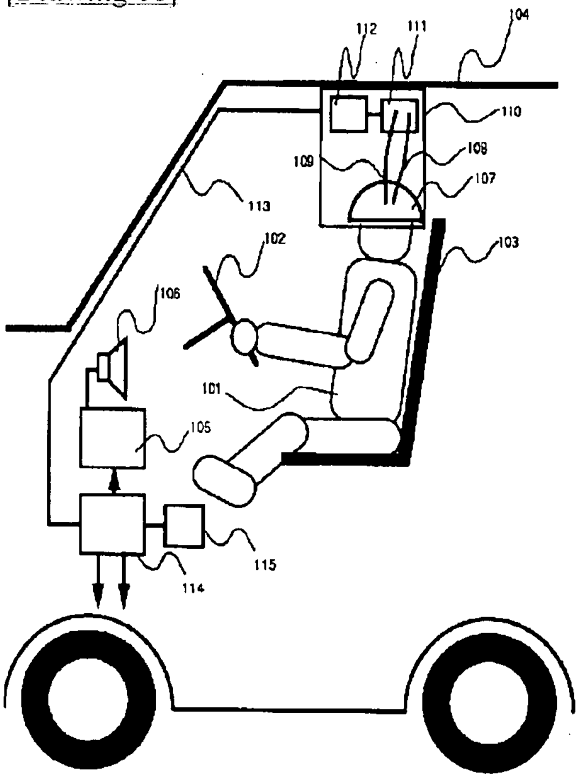
[Drawing 7]


計測領域１の
ヘモグロビン濃度演算
step1-1
特徴パラメータ演算
step1-2
閾値範囲内
step1-3
yes
信号１出力
no
計測領域２の
ヘモグロビン濃度演算
step1-4
特徴パラメータ演算
step1-5
閾値範囲内
step1-6
yes
信号２出力
no
計測領域３の
ヘモグロビン濃度演算
step1-7
特徴パラメータ演算
step1-8
閾値範囲内
step1-9
yes
信号３出力
no

[Drawing 9]

特徴パラメータ j / 計測領域 i	1	2	....	m−1	m
1	$S_{1,1,k}$ $A_{1,1,k}$	$S_{1,2,k}$ $A_{1,2,k}$	....	$S_{1,m-1,k}$ $A_{1,m-1,k}$	$S_{1,m,k}$ $A_{1,m,k}$
2	$S_{2,1,k}$ $A_{2,1,k}$	$S_{2,2,k}$ $A_{2,2,k}$	....	$S_{2,m-1,k}$ $A_{2,m-1,k}$	$S_{2,m,k}$ $A_{2,,m,k}$
⋮	⋮	⋮	⋱	⋮	⋮
n−1	$S_{n-1,1,k}$ $A_{n-1,1,k}$	$S_{n-1,2,k}$ $A_{n-1,2,k}$	....	$S_{n-1,m-1,k}$ $A_{n-1,m-1,k}$	$S_{n-1,m,k}$ $A_{n-1,m,k}$
n	$S_{n,1,k}$ $A_{n,1,k}$	$S_{n,2,k}$ $A_{n,2,k}$	....	$S_{n,m-1,k}$ $A_{n,m-1,k}$	$S_{n,m,k}$ $A_{n,m,k}$

[Drawing 10]



[Translation done.]